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ABSTRACT

This study measured Saskatchewan high school students' achievement of selected mathematical competencies. It provided baseline data useful to educators for improvement of current educational programs and also provided benchmarks for future assessments. The study also determined the effect of grade level, mathematics program, school enrollment size, and student sex on achievement. Findings indicated: (1) Grade nine students were not able to achieve a majority of the 48 "basic" mathematical competencies released by the National Council of Teachers of Mathematics in 1972; (2) Grade ten students achieved 50% of the competencies while students in grades eleven and twelve achieved a clear majority; and (3) After certain adjustments, statistically significant differences in student mean achievement existed among some grades, mathematics programs, school enrollment sizes, and between sexes. (MK)

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THE ATTAINMENT OF SELECTED MATHEMATICAL COMPETENCIES BY HIGH SCHOOL STUDENTS IN SASKATCHEWAN

Edwin C. Giesbrecht

S.S.T.A. Research Centre Report No. 48

A report with recommendations prepared under the auspices of the Saskatchewan School Trustees Association Research Centre.

March, 1978

Note: The opinions expressed in this report are those of the author and may or may not be in agreement with SSTA officers or trustees, but are offered as being worthy of consideration by those responsible for making decisions.

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BIOGRAPHICAL SKETCH

Dr. Edwin C. Giesbrecht received his Ph.D in secondary mathematics education from the University of Saskatchewan in 1977. He also holds a M. Math. degree from the University of Waterloo and a B.A. (Hons) and B.Ed. degrees from the University of Regina.

Dr. Giesbrecht is Associate Professor in the Department of Mathematics at Algoma University College in Sault Ste. Marie, Ontario, where he has been employed since 1970. He currently is chairman of the University's Division of Physical and Biological Sciences.

Prior to joining the faculty of Algoma University College, Dr. Giesbrecht taught high school for one year in Sault Ste. Marie, Ontario, and one year in Coronach, Saskatchewan. He also taught at the elementary level (grades one to eight) for two years in Harptree, Saskatchewan.

Dr. Giesbrecht's recent research project under the supervision of Dr. James E. Beamer and with the financial support of the SSTA, investigated the achievement of mathematical competence by Saskatchewan high school students. An article based on this research currently is being submitted to the school Science and Mathematics Association for publication.

A. The Most Significant Finding of the Project

1. Grade nine Saskatchewan students enrolled in mathematics programs during the 1975-76 school year were not able to achieve a majority of the forty-eight "basic" mathematical competencies released by the National Council of Teachers of Mathematics (NCTM) in 1972.[1] Grade ten students achieved 50 percent of the competencies while grades eleven and twelve students achieved a clear majority.
2. When adjustments were made for intelligence, statistically significant differences (at the 5 percent level of significance) in high school student mean (average) achievement of total competencies (out of forty-eight) existed among some grades, mathematics programs, school enrolment sizes, and between sexes.

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[1] This list is shown in Table 1 of the Appendix.

B. Purpose Of The Project

The purpose of this study was to measure Saskatchewan high school students' achievement of selected mathematical competencies, and thereby provide descriptive measures of performance in mathematics required for full participation in contemporary society by the average citizen. This assessment would thus provide baseline data useful to educators for improvement of current mathematical programs, and would also provide benchmarks for future assessments in the area of basic mathematical competence.

A second purpose of this study was to determine the effects of any of the following four factors on Saskatchewan high school students' achievement of a selected list of mathematical competencies: grade level --grade nine, grade ten, grade eleven, and grade twelve, mathematics program[2]--algebra, algebra-geometry (trigonometry), alternate mathematics, and general mathematics, school enrolment size--small--1 to 87 students, medium--88 to 156 students, and large--157 to 1816 students, student sex--female and male.

The two purposes of this research project were stated in terms of the following research question and four null hypothesis:

Research Question: To what degree have Saskatchewan high school students achieved the forty-eight mathematical competencies outlined in the 1972 report of the NCTM?

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[2]See Table II in the Appendix for definition of programs.

Hypotheses tested

1. There are no statistically significant differences in attainment of mathematical competencies of high school students among each of the four grade levels; that is, between the ninth and the tenth, eleventh, and twelfth grades, between the tenth and the eleventh and twelfth grades, and between the eleventh and twelfth grades.

2. There are no statistically significant differences in attainment of mathematical competencies at each high school grade level by students in different programs; that is, those enrolled in algebra, algebra-geometry (trigonometry), alternate mathematics, and general mathematics programs.

3. There are no statistically significant differences in attainment of mathematical competencies of high school students at each grade level in schools of differing enrolments.

4. There are no statistically significant differences in attainment of mathematical competencies between female and male high school students at each grade level.

C. Procedures And Sample Used

Stratified[3] random sampling techniques were employed to obtain a sample representative of the population of Saskatchewan students enrolled in secondary school mathematics programs during the 1975-76 school year. A proportionate number of high school students were selected randomly from Saskatchewan's six school regions (now eight), from four different mathematics programs, from three different categories of school enrolment sizes, and from the two student sexes.

All high schools in Saskatchewan offering mathematics programs in grades nine through twelve were requested to particpate in this study. Usable test results were received from 161 high schools; that is, results were received from the following number of students in each of grades nine through twelve respectively: 858, 856, 816, and 765. These numbers represent approximately 5 percent of the students enrolled in each high school grade.

The Beckmann-Beal Test and the Verbal Reasoning and Numerical Ability subtest of the Differential Aptitude Tests battery were administered by local teachers and guidance counsellors to all students in the sample.[4] The testing was conducted during the one-month interval from May 15 to June 15, 1976.

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[3]This sampling technique permits proportionate representation from each subgroup of the population.

[4]The Beckmann-Beal Test is a mathematical literacy test based on the list of forty-eight competencies mentioned above. It contains ninety-six questions, two per competency. The VR + NA subtest, one of nine subtests in the Differential Aptitude Tests battery, was selected as the instrument to measure intelligence.

The data obtained from the sample were analyzed as follows. A tabulation was made of the number and percentage of students, in each of grades nine through twelve, that attained each of the forty-eight competencies released by the NCTM in 1972.[5] The number of students, together with the mean, standard deviation, and range were determined for raw scores (score out of ninety-six), total competencies,[6] and the ten competency areas in each of the following categories: grade level, mathematics program, school size, and student sex. Analysis of covariance techniques, with intelligence as the covariate, were used to test for significant differences in mean attainment of total and area competencies among the above four categories. This technique may be used to control or adjust for the effects of an uncontrolled variable, thereby permitting a valid evaluation of the outcome of an experiment. Scheffé's method was used to compare means if significant differences existed.

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[5] See Table III in the Appendix.

[6] A competency was said to have been attained only if a student correctly responded to both test related questions on The Beckmann-Beal Test.

D. Major Findings

The following is a summary of the results of the study.

1. The mean score and standard deviation respectively for raw scores in each of the four grades were as follows: grade nine--60.7 (63.2%), 15.6, grade ten--65.9 (68.7%), 14.8, grade eleven--71.4 (74.3%), 13.3, grade twelve--75.9 (79.1%), 12.5.

2. The mean score and standard deviation respectively for total competencies in each of the four grades were as follows: grade nine--20.8 (43.3%), 9.7, grade ten--24.3 (50.5%), 9.8, grade eleven--27.8 (57.9%), 9.5, grade twelve--31.1 (64.7%), 9.2.

3. There were statistically significant differences in mean competency totals adjusted for intelligence between students in grade nine and in grades ten, eleven, and twelve, and between students in grade ten and grade twelve. These differences favored the students in the higher grade level at the 0.05 level of significance.

4. There were no statistically significant differences in mean competency totals adjusted for intelligence between students in grade ten and grade eleven, and between students in grade eleven and grade twelve.

5. There was no statistically significant difference in mean competency totals adjusted for intelligence between grade nine students enrolled in the algebra program and those students enrolled in the general mathematics program. This result corresponds with earlier findings reported by Beckmann in 1951 and in 1969.[7]

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[7]These findings are reported in the body of the thesis written by the author.

6. There were statistically significant differences in mean competency totals adjusted for intelligence between students enrolled in the algebra-geometry (trigonometry) program and students enrolled in any of the algebra, alternate mathematics, or general mathematics programs at the tenth, eleventh, and twelfth grade levels. These differences favored the students enrolled in the algebra-geometry (trigonometry) program at the 0.05 level of significance.

The higher scores obtained in the competency area involving geometry by students enrolled in the algebra-geometry (trigonometry) program may be partially responsible for the above statistically significant differences in mean competency totals adjusted for intelligence. This observation concurs with a finding reported by Renner in 1955. Adjusted mean competency totals increased at the grade twelve level in the algebra-geometry (trigonometry) program while decreases were observed in the algebra and the general mathematics programs. This probably is indicative of more extensive coverage of the forty-eight competencies outlined in the 1972 report by the algebra-geometry (trigonometry) program than by algebra and general mathematics programs at the twelfth grade level.

7. There were statistically significant differences in mean competency totals adjusted for intelligence between students enrolled in the algebra program and students enrolled in the general mathematics program at the tenth, eleventh, and twelfth grade levels. These differences favored students enrolled in the algebra program at the 0.05 level of significance.

8. There were no statistically significant differences in mean competency totals adjusted for intelligence between students enrolled in the algebra program and students enrolled in the alternate mathematics program, or between students enrolled in the alternate mathematics program and students enrolled in the general mathematics program.

9. There were statistically significant differences in mean competency totals adjusted for intelligence between students attending large enrolment size schools and those attending either small, or medium, enrolment size schools. These differences favored students attending either small, or medium, enrolment size schools at the 0.05 level of significance.

Factors responsible for the above result may include magnitude of size classifications and pupil-teacher ratios. The absence of Departmental examinations in larger accredited schools may be responsible for lower levels of achievement in basic mathematical competence. Students in smaller schools have fewer subject options and a higher percentage of them tend to be enrolled in the algebra-geometry (trigonometry) program. The majority of students whose mother tongue is not English probably attend the larger schools in cities. These students tend to have difficulties in reading and the correlation between student achievement on reading tests and mathematic tests is generally quite high. Only large schools offer vocational and general mathematics programs. Students in general mathematics programs achieved consistently the lowest level of basic mathematical competence in the four mathematics programs across the tenth, eleventh, and twelfth grade levels, even after adjustments were made for intelligence.

10. There was no statistically significant difference in mean competency totals adjusted for intelligence between students attending small enrolment size schools and those attending medium enrolment size schools.

11. There was a statistically significant difference in mean competency totals adjusted for intelligence between female and male students. The difference favored male students at the 0.05 level of significance. There was strong agreement of this pattern in similar studies reviewed in the literature.

Possibly a significant factor responsible for this difference in achievement between the sexes is society's tendency to designate mathematics as a male domain, thereby causing females to lose interest and confidence in mathematics as they grow older.

12. The above statistically significant differences in mean competency totals adjusted for intelligence over four factors, grade level, mathematics program, school enrolment size, and student sex, generally were reflected in the majority of the ten competency areas.

The following exceptions were noted. Statistically significant differences in mean competency totals adjusted for intelligence between students enrolled in the algebra-geometry (trigonometry) program and students enrolled in the alternate mathemtics program at the tenth, eleventh, and twelfth grade levels were reflected in only two competency areas. Statistically significant differences in mean competency totals adjusted for intelligence between students enrolled in the algebra

program and students enrolled in the general mathematics program at the tenth, eleventh, and twelfth grade levels were reflected in only three competency areas. Also, statistically significant differences in mean competency totals adjusted for intelligence between students attending large enrolment size schools and students attending either small or medium enrolment size schools were reflected in only the first four of the ten competency areas.

E. Conclusions

1. In response to the research question, namely, to what degree have Saskatchewan high school students achieved the forty-eight mathematical competencies outlined in the 1972 report of the NCTM, it was found that the mean competency totals for students in grades nine, ten, eleven, and twelve were 20.79, 24.26, 27.80, and 31.07, respectively. A mean score in excess of twenty-four out of forty-eight was required to achieve a majority of the competencies. Consequently, grade nine students did not attain a majority of the mathematical competencies. whereas students in grades ten, eleven, and twelve did attain a majority of the mathematical competencies required for enlightened citizenship in contemporary society as defined by The Committee on Basic Mathematical Competencies and Skills of the NCTM in 1972.

2. Since there were statistically significant ($p < 0.05$) differences in mean competency totals adjusted for intelligence between students in grade nine and those in grades ten, eleven, or twelve, and also between students in grade ten and those in grade twelve, the first hypothesis, no statistically significant differences exist among high school grade levels in mathematical competency attainment, was rejected.

3. Since there were statistically significant ($p < 0.05$) differences in mean competency totals adjusted for intelligence between students enrolled in the algebra-geometry (trigonometry) program and students enrolled in any of the algebra, alternate mathematics, or general mathematics programs at the tenth, eleventh, and twelfth grade levels, and since there also were statistically significant ($p < 0.05$) differences

in mean competency totals adjusted for intelligence between students enrolled in the algebra program and students enrolled in the general mathematics program at the tenth, eleventh, and twelfth grade levels, the second hypothesis, no statistically significant differences exist among high school mathematics programs in mathematical competency attainment, was rejected.

4. Since there were statistically significant ($p < 0.05$) differences in mean competency totals adjusted for intelligence between students who attended large enrolment size schools and those who attended either small or medium enrolment size schools, the hypothesis, no statistically significant differnce exists among school enrolment size in mathematical competency attainment, was rejected.

5. Since male high school students attained a significantly ($p < 0.05$) greater number of mathematical competency totals than female high school students, after adjustments were made for intelligence, the hypothesis, no statistically significant difference exists between male and female high school students in mathematical competency attainment, was rejected.

6. In summary, based upon the evidence of this study, one can conclude that, when adjustments are made for intelligence, statistically significant differences in high school student mean achievement of total competencies existed among some grades, mathematics programs, school enrolment sizes, and between the sexes.

F. Implications For Further Research

1. Further assessments of attainment of basic mathematical competence by Saskatchewan high school students should be conducted over three to five year intervals. This would permit the establishment of trends in basic mathematical achievement. It also would provide for evaluation of improvements and/or alterations in mathematcs programs.

2. Research of female high school students' low scores, relative to males, is essential in order to determine causal factors. It appears that the attitude of many students, parents, and educators is that mathematics is more appropriate and important for boys than for girls. Consequently, girls may lack high achievement motivation and see no relevance of mathematics in their future lives. Recent studies have shown positive correlation between self-esteem and achievement in mathematics for girls but not for boys below the tenth grade level. It is possible that, beginning in areas of mathematics where girls and boys do equally well, or where girls outperform boys (for example, competency areas 2, 3, and 9 dealing with operations and properties, mathematical sentences, and mathematical reasoning respectively), girls' self-confidence in mathematics can be increased.

3. Investigation of factors responsible for varying degrees of achievement of basic mathematic competence in schools of differing enrolment size is suggested. Factors to be examined might include the following: magnitude of size classifications, pupil-teacher ratios, Departmental examinations (or absence thereof, in accredited schools), number of available course options, non-English mother tongue, vocational programs in larger comprehensive schools.

4. Further research should be considered to determine what constitutes an acceptable level of basic mathematical competence for the average Canadian citizen. Definition of such a level has proved to be extremely difficult and, to date, the author is not aware of any recommendations that have been posited. It may be that no general definition of an acceptable level of basic mathematical competence will be found to exist. Rather, educators may support a definition consisting of differing levels for each of the ten competency areas outlined by the NCTM in 1972, and also for each of the four high school grade levels.

G. Recommendations For Practice

The following recommendations are based upon the findings of this study.

Recommendation 1: The Saskatchewan high school system should define an acceptable level of basic mathematical competence required by the average Canadian citizen for satisfactory participation in contemporary society.

This definition is a prerequisite to any conclusions that might be drawn with regard to the level of basic mathematical literacy achieved by Saskatchewan high school students. The Committee on Basic Mathematical Competencies and Skills of the NCTM did not go beyond saying that it felt it was necessary for the majority of adults in contemporary society to achieve a mojority of the forty-eight mathematical competencies listed in the 1972 report.

Recommendation 2: Mathematics curriculum developers, mathematics department heads, and teachers at local levels in Saskatchewan high school systems should consult the list of forty-eight competencies as they plan curriculum and establish goals and objectives.

Consultation of this list would enhance the probability of all students enrolled in Saskatchewan mathematics programs achieving a higher level of attainment of basic mathematical competence.

Recommendation 3: The Saskatchewan Department of Education should maintain its current minimum requirement of at least two credits in mathematics for receipt of a high school diploma.

This recommendation is tenable in view of the 1972 NCTM report which states that facility with the majority of the forty-eight competencies contained in the report is necessary for full participation in current technological society. The findings of this study revealed that students in the sample achieved mastery of a majority of the forty-eight competencies only after studying mathematics at both the ninth and tenth grade levels.

Recommendation 4: The existing ninth grade Saskatchewan mathematics curriculum should be critically examined with consideration given to placing first a greater emphasis on the acquisition of those skills prerequisite to satisfactory participation in contemporary society. Competencies necessary for the scientist, engineer, and pure mathematician should receive secondary emphasis.

This recommendation is based upon the following observations. Grade nine students enrolled in either the algebra or general mathematics program did not achieve mastery of a majority of the competencies required for enlightened citizenship in contemporary society. The gain in adjusted mean competency totals was approximately twice as great between the ninth and tenth grade levels as it was between the tenth and eleventh or the eleventh and twelfth grade levels.

Recommendation 5: Consideration should be given to the administration of The Beckmann-Beal Test to all students entering ninth grade level mathematics program.

Ninth grade level students in Saskatchewan achieved a relatively low level of basic mathematical competence. The Beckmann-Beal Test scores

would assist in the identification of areas in which students exhibit the greatest deficiencies and enhance the attainment of a higher level of basic mathematical competence.

Recommendation 6: Administration of The Beckmann-Beal Test at the beginning and the end of each of grades ten, eleven, and twelve should be considered.

This would provide a clearer focus on basic mathematical objectives and provide for measurement of their attainment.

Recommendation 7: Saskatchewan high school systems should give serious consideration to the improvement of mathematics curricula and instruction in the following three competency areas: probability and statistics, geometry, business and consumer mathematics.[8]

High school students across the four grade levels achieved consistently the lowest level of mathematical competence in these three competency areas. The following decreases in adjusted mean competency areas across the tenth, eleventh, and twelfth grade levels also were noted. Grade ten students in the alternate and general mathematics programs achieved scores 0.23 and 0.28 respectively while grade eleven students achieved scores 0.16 and 0.21 respectively in competency area 7 (probability and statistics). Grade ten students in the general mathematics program achieved a score of 0.39 while grade eleven and twelve students achieved scores of 0.31 and 0.29 respectively in competency area 4 (geometry). In competency area 10, business and consumer mathematics,

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[8]The mean attainment of competencies in each of the ten areas is provided in Table IV of the Appendix.

grade eleven students in the alternate and general mathematics programs achieved scores 0.49 and 0.48 respectively while grade twelve students achieved scores 0.45 and 0.38 respectively.

Recommendation 8: Consideration should be given to increasing enrolment in Geometry 10 and Geometry 20.

Only 31 percent and 25 percent of grade ten and eleven students respectively were enrolled in geometry. Also, during 1976-77, Geometry 10 and Geometry 20 both experienced a decreased enrolment of 5 percent, while enrolment in Algebra 10 and Algebra 20 increased slightly over the same time period.

Recommendation 9: Consideration should be given to the problem of increasing the enrolment in alternate mathematics programs in the province of Saskatchewan.

This recommendation is based upon the following observation. After adjustments were made for intelligence, there were fewer statistically significant ($p < 0.05$) differences in mean competency areas between students enrolled in the algebra-geometry (trigonometry) program and students enrolled in either the algebra or general mathematics program at the tenth, eleventh, and twelfth grade levels. Yet only about 4 percent, 3 percent, and 2 percent of students enrolled in Saskatchewan mathematics programs at the tenth, eleventh, and twelfth grade levels respectively were enrolled in alternate mathematics. This trend continues in spite of the Division IV Mathematics Curriculum Committee's expectation that the majority of high school students would enrol in the alternate mathematics program.

Recommendation 10: Attempts should be made to improve the level of student achievement attained in competency area 4 (geometry) by grade eleven students in the alternate program.

Both the unadjusted and adjusted mean scores for this competency area were disportionately low in Alternate Mathematics 20.

Recommendation 11: The Saskatchewan education system should consider taking steps necessary to assist in the removal of any sex bias in the area of mathematics, such as a tendency of society in general to designate mathematics as a male domain, thereby lowering females' level of motivation and self-confidence in the study of mathematics.

Statistically significant ($p < 0.05$) differences in achievement of mathematical competence existed between the sexes, in favor of males, for mean competency totals, and over most competency areas, after adjustments were made for intelligence.

Recommendation 12: The entrance requirements of post-secondary institutions for programs in mathematical, scientific, or highly technical fields should consist of completion of the algebra-geometry (trigonometry) program.

Statistically significant ($p < 0.05$) differences existed in mean competency totals adjusted for intelligence between students enrolled in the algebra-geometry (trigonometry) program and students enrolled in the algebra, alternate mathematics, or general mathematics programs at the tenth, eleventh, and twelfth grade levels.

Recommendation 13: Post-secondary programs requiring only an average level of mathematical competence should require completion of either the algebra or the alternate mathematics program.

No statistically significant ($p < 0.05$) difference existed in mean competency totals adjusted for intelligence between students enrolled in the algebra program and students enrolled in the alternate mathematics program at the tenth, eleventh, and twelfth grade levels.

APPENDIX

TABLE I

NATIONAL COUNCIL OF TEACHERS OF MATHEMATICS
LIST OF 48 BASIC MATHEMATICAL
OMPETENCIES AND SKILLS

Numbers and numerals

1. Express a rational number using decimal notation
2. List the first ten multiples of 2 through 12
3. Use the whole numbers in problem solving
4. Recognize the digit, its place value, and the number represented through billions
5. Describe a given positive rational number using decimal, percent, or fractional notation
6. Convert to roman numerals from decimal numerals and conversely (e.g. date translation)
7. Represent very large and very small numbers using scientific notation

Operations and Properties

8. Write equivalent fractions for given fractions, such as 1/2, 2/3, and 3/5
9. Use the standard algorithms for the operations of arithmetic of positive rational numbers
10. Recognize and use properties of operations (groupings, order, etc.) and properties of certain numbers with respect to operations ($a \cdot 1 = a$; $a + 0 = a$;)
11. Solve addition, subtraction, multiplication, and division problems involving fractions
12. Solve problems involving percent
13. Perform arithmetic operations with measures
14. Estimate results
15. Judge the reasonableness of answers to computational problems

TABLE I (continued)

Mathematical sentences

16. Construct a mathematical sentence from a given verbal problem

17. Solve simple linear equations, such as a + 3 = 12; 16·n = 4; n/3 = 7; and 4a - 2 = 18

18. Translate mathematical sentences into verbal problems

Geometry

19. Recognize horizontal lines, vertical lines, parallel lines, perpendicular lines, and intersecting lines

20. Classify simple plane figures by recognizing their properties

21. Compute perimeters of polygons

22. Compute the areas of rectangles, triangles, and circles

23. Be familiar with the concepts of similarity and congruence of triangles

Measurement

24. Apply measures of length, area, volume (dry or liquid), weight, time, money, and temperature

25. Use units of length, area, mass, and volume in making measurements

26. Use standard measuring devices to measure length, area, volume, time, and temperature

27. Round off measurements to the nearest given unit of the measuring device (ruler, protractor, thermometer, etc.) used

28. Read maps and estimate distances between locations

Relations and functions

29. Interpret information from a graphical representation of a function

30. Apply the concepts of ratio and proportion to construct scale drawings and to determine percent and other relations

31. Write simple sentences showing the relations =, < , > , and ≠ for two given numbers

TABLE I (continued)

Probability and statistics

32. Determine mean, median, and mode for given numerical data

33. Analyze and solve simple propability problems, such as tossing coins or drawing one red marble from a set containing one red and four white marbles

34. Estimate answers to computational problems

35. Recognize the techniques used in making predictions and estimates from samples

Graphing

36. Determine measures of real objects from scale drawings

37. Construct scale drawings of simple objects

38. Construct graphs indicating relationships of two variables from given sets of data

39. Interpret information from graphs and tables

Mathematical reasoning

40. Produce counterexamples to test the validity of statements

41. Detect and describe flaws and fallacies in advertising and propaganda where statistical data and inferences are employed

42. Gather and present data to support an inference or argument

Business and consumer mathematics

43. Maintain personal bank records

44. Plan a budget including record keeping of personal expenses

45. Apply simple interest formulas to installment buying

46. Estimate the real cost of an article

47. Compute taxes and investment returns

48. Use the necessary mathematical skills to appraise insurance and retirement benefits

TABLE II

HIGH SCHOOL MATHEMATICS PROGRAMS

	Algebra	Alg-Geom (Trig)	Alternate Math	General Math
Grade 9	Alg 9	Alg 9	Alg 9	G.M. 9 or Alg 9
Grade 10	Alg 10	Alg 10 (Geom 10)*	Math 10	G.M. 10
Grade 11	Alg 20	Alg 20 (Geom 20)*	Math 20	G.M. 20
Grade 12	Alg 30	Alg 30, Trig 30**	Math 30	G.M. 30

*The parentheses on Geometry 10 and Geometry 20 mean that some students at each grade level may, or may not, have been enrolled in these courses in this particular program, depending upon the school which they attend and their personal selection of courses.

**Trigonometry 30 refers to the Grade 12 Geometry-Trigonometry course as outlined by the Department of Education (1972:26-28) for the province of Saskatchewan.

TABLE III

NUMBER AND PERCENTAGE OF STUDENTS ATTAINING
EACH OF THE FORTY-EIGHT COMPETENCIES

Competency	Grade 9 Students		Grade 10 Students		Grade 11 Students		Grade 12 Students	
	No.	%	No.	%	No.	%	No.	%
1. Changing rationals to decimals	360	42.0	461	53.9	512	62.7	535	69.9
2. Knowing multiples of 2 through 12	608	70.9	635	74.2	651	79.8	651	85.1
3. Solving proglems with whole numbers	275	32.1	378	44.2	420	51.5	534	69.8
4. Recognizing number value and place value	511	59.6	577	67.4	593	72.7	599	78.3
5. Expressing numbers as decimals or percents	420	49.0	487	56.9	567	69.5	590	77.1
6. Changing Roman numerals to the Hindu-Arabic and vice-versa	278	32.4	282	33.0	318	39.0	312	40.8
7. Using scientific notation	365	42.5	484	56.6	580	71.0	618	80.8
8. Writing equivalent fractions	526	61.3	528	61.7	547	67.0	551	72.0
9. Using arithmetic algorithms for rationals	474	55.2	531	62.0	572	70.1	593	77.5
10. Using properties of arithmetic operations	439	51.2	482	56.3	534	65.4	535	69.9
11. Solving problems involving rationals	471	54.9	549	64.1	577	70.7	590	77.1
12. Solving problems involving percent	329	38.4	400	46.7	439	53.8	486	63.5
13. Working with measures	498	58.0	550	64.3	569	69.7	594	77.6
14. Estimating results	219	25.5	259	30.2	359	44.0	411	53.7
15. Judging reasonableness of answers to problems	365	42.5	412	48.1	443	54.3	437	57.1
16. Writing math sentences from verbal problems	487	56.8	568	66.4	577	70.7	617	80.7
17. Solving simple linear equations	650	75.8	668	78.0	667	81.7	665	86.9
18. Translating math sentences to English	240	28.0	293	34.2	328	40.2	287	37.5
19. Recognizing kinds of lines	284	33.1	444	51.9	530	65.0	526	68.7
20. Recognizing simple plane figures	172	20.0	263	30.7	320	39.2	340	44.4
21. Computing perimeters of polygons	302	35.2	345	40.3	410	50.2	424	55.4
22. Computing areas of polygons and circles	183	21.3	221	25.8	312	38.2	383	50.1
23. Familiarity with similar and congruent triangles	436	50.8	532	62.1	610	74.7	597	78.0
24. Applying nonstandard measure	266	31.0	306	35.8	351	43.0	391	51.1

TABLE III (continued)

Competency	Grade 9 Students No.	%	Grade 10 Students No.	%	Grade 11 Students No.	%	Grade 12 Students No.	%
25. Using standard measure	491	57.2	538	62.9	565	69.2	584	76.3
26. Using standard measuring devices	614	71.6	659	77.0	658	80.6	660	86.3
27. Rounding off measurements	401	46.7	477	55.7	526	64.5	538	70.3
28. Reading maps	219	25.5	260	30.4	263	32.2	281	36.7
29. Using graphs of functions	429	50.0	484	56.6	542	66.4	569	74.4
30. Using ratio and proportion	463	54.0	534	62.4	587	71.9	609	79.6
31. Using sentences with equalities and inequalities	309	36.0	428	50.0	456	55.9	454	59.3
32. Determining mean, median, and mode	43	5.0	38	4.4	50	6.1	64	8.4
33. Solving probability problems	199	23.2	223	26.0	266	32.6	388	50.7
34. Estimating probability	199	23.2	229	26.8	264	32.4	244	31.9
35. Recognizing techniques of prediction and estimation from samples	254	29.6	276	32.2	310	38.0	381	49.8
36. Determining real sizes from scale drawings	377	43.9	468	54.7	504	61.8	523	68.4
37. Constructing scale drawings	150	17.5	251	29.3	314	38.5	394	51.5
38. Constructing graphs of two variables	396	46.2	567	66.2	610	74.8	615	80.4
39. Obtaining information from graphs	562	65.5	609	71.2	628	77.0	602	78.7
40. Testing validity of statements	654	76.2	707	82.6	730	89.5	715	93.5
41. Detecting misuse of statistics	435	50.7	570	66.6	593	72.7	605	79.1
42. Using data to support an argument	274	31.9	287	33.5	335	41.0	379	49.5
43. Maintaining personal bank records	546	63.6	645	75.4	671	82.2	677	88.5
44. Planning a budget	240	28.0	305	35.6	384	47.0	422	55.2
45. Determining interest on installment buying	239	27.8	314	36.7	354	43.4	374	48.9
46. Estimating the real cost of an article	529	61.7	632	73.8	648	79.4	637	83.3
47. Computing taxes and investment returns	47	5.5	67	7.8	100	12.2	198	25.9
48. Appraising insurance and retirement benefits	249	29.0	294	34.3	374	45.8	412	53.9

TABLE IV

MEAN ATTAINMENT OF THE COMPETENCIES LISTED IN THE TEN AREAS BY STUDENTS IN GRADES 9, 10, 11, AND 12

	Competency Area	Grade 9 Mean	Grade 10 Mean	Grade 11 Mean	Grade 12 Mean
1.	Numbers and Numerals	0.48	0.56	0.64	0.73
2.	Operations and properties	0.49	0.55	0.62	0.69
3.	Mathematical sentences	0.54	0.60	0.64	0.69
4.	Geometry	0.33	0.43	0.54	0.60
5.	Measurement	0.47	0.53	0.58	0.65
6.	Relations and functions	0.48	0.57	0.65	0.72
7.	Probability and statistics	0.20	0.22	0.27	0.36
8.	Graphing	0.45	0.56	0.64	0.71
9.	Mathematical reasoning	0.54	0.61	0.69	0.75
10.	Business and consumer mathematics	0.37	0.44	0.52	0.59